

The documentation and process conversion measures necessary to comply with this revision shall be completed by 5 June 2002.

INCH-POUND

MIL-PRF-19500/446C
5 March 2001
SUPERSEDING
MIL-PRF-19500/446B
2 July 1999

PERFORMANCE SPECIFICATION

SEMICONDUCTOR DEVICE, SILICON, HIGH-POWER, SINGLE PHASE,
FULL WAVE BRIDGE RECTIFIER, JAN, JANTX, AND JANTXV
TYPES SPA25, SPB25, SPC25, SPD25

This specification is approved for use by all Departments
and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the performance requirements for silicon, single phase, full wave rectifiers. Three levels of product assurance are provided for each device type as specified in MIL-PRF-19500.

1.2 Physical dimensions. See figure 1.

1.3 Maximum ratings.

Type number	V_{RWM}	Bridge (1) I_{O1} at $T_C = +55^\circ\text{C}$	Bridge (2) I_{O2} at $T_C = +100^\circ\text{C}$	$I_{F(surge)}$ $I_O = 25\text{ A dc}$ $T_C = +55^\circ\text{C}$ $t_p = 8.3\text{ ms}$	Barometric pressure reduced	T_{rr} $I_F = 0.5\text{ A}$ $I_R = 1.0\text{ A}$ $I_{rec} = 0.25\text{ A}$
	<u>V (pk)</u>	<u>A dc</u>	<u>A dc</u>	<u>A (pk)</u>	<u>mm Hg</u>	<u>μs</u>
SPA25	100	25	15	150	8	2.5
SPB25	200	25	15	150	8	2.5
SPC25	400	25	15	150	8	2.5
SPD25	600	25	15	150	8	2.5

- (1) Derate from 25 A dc at $+55^\circ\text{C}$ to 15 A dc at $+100^\circ\text{C}$ (222 mA dc/ $^\circ\text{C}$).
- (2) Derate from 15 A dc at $+100^\circ\text{C}$ to 0 A dc at $+150^\circ\text{C}$ (300 mA dc/ $^\circ\text{C}$). Operating temperature: -65°C to $+150^\circ\text{C}$. Storage ambient temperature: -65°C to $+150^\circ\text{C}$.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Defense Supply Center Columbus, ATTN: DSCC-VAC, P.O. Box 3990, Columbus, OH 43216-5000, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A
DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

FSC 5961

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATION

DEPARTMENT OF DEFENSE

MIL-PRF-19500 - Semiconductor Devices, General Specification for.

STANDARD

DEPARTMENT OF DEFENSE

MIL-STD-750 - Test Methods for Semiconductor Devices.

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Document Automation and Production Services (DAPS), Building 4D (DPM-DODSSP), 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

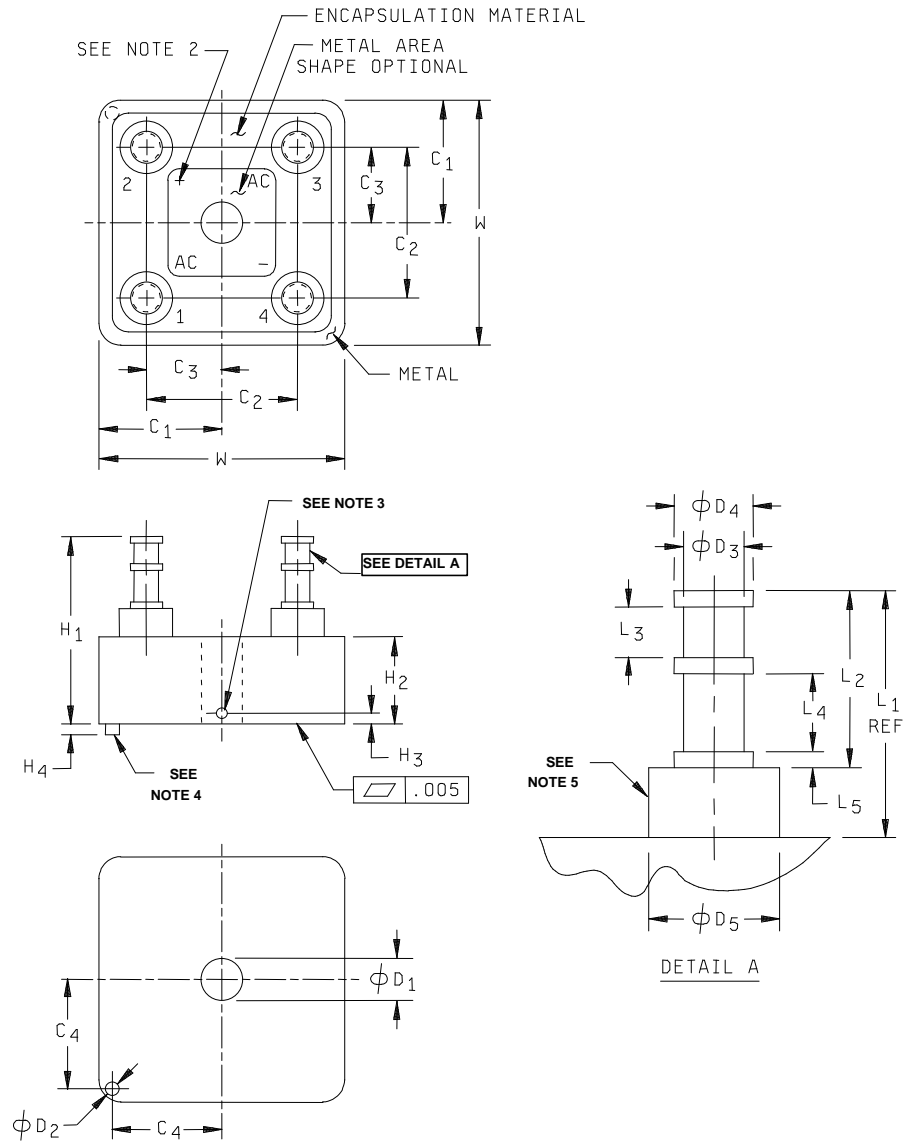
3. REQUIREMENTS

3.1 General. The requirements for acquiring the product described herein shall consist of this document and MIL-PRF-19500.

3.2 Qualification. Devices furnished under this specification shall be products that are manufactured by a manufacturer authorized by the qualifying activity for listing on the applicable qualified manufacturer's list (QML) before contract award (see 4.2 and 6.4).

3.3 Abbreviations, symbols, and definitions. Abbreviations, symbols, and definitions used herein shall be as specified in MIL-PRF-19500.

3.4 Interface and physical dimensions. The interface and physical dimensions shall be as specified in MIL-PRF-19500 and on figure 1 herein.



* FIGURE 1. Physical dimensions.

Ltr	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
C ₁	.552	.572	14.02	14.53
C ₂	.624	.760	15.85	19.30
C ₃	.312	.380	7.92	9.65
C ₄	.495	.512	12.57	13.00
φD ₁	.189	.195	4.80	4.95
φD ₂	.057	.067	1.45	1.70
φD ₃	.108	.118	2.74	3.00
φD ₄	.141	.151	3.58	3.84
φD ₅	.225	.260	5.72	6.60
H ₁	.690	1.060	17.53	26.92
H ₂	.300	.500	7.62	12.70
H ₃	.040	.060	1.02	1.52
H ₄	.042	.062	1.07	1.57
L ₁	.370	.560	9.40	14.22
L ₂	.307	.365	7.80	9.27
L ₃	.089	.099	1.49	2.49
L ₄	.132	.163	3.35	4.14
L ₅	.026	.036	0.66	0.91
L ₁	.370	.560	9.40	14.22
L ₂	.307	.365	7.80	9.27
L ₃	.089	.099	1.49	2.49
L ₄	.132	.163	3.35	4.14
L ₅	.026	.036	0.66	0.91
W	1.104	1.144	28.04	29.06

NOTES:

1. Dimensions are in inches. Metric equivalents are given for general information only.
2. Polarity shall be marked on the terminal side of the device. Terminal numbers are for reference and do not have to be marked on the bridge.
3. Point at which T_C is read shall be in metal part of case as shown on drawing.
4. The locating pin shall be adjacent to the positive (+) terminal.
5. Insulating sleeve shall be alumina (AL₂ O₃) composite material or equivalent.
6. The areas defined by the dimensions "L3" and "L4" are both acceptable for wire wrap and soldering.

FIGURE 1. Physical dimensions - Continued.

3.4.1 Internal construction. The rectifier bridge shall consist of a metal and plastic encased assembly of discrete diodes. Each discrete diode shall be a glass-to-metal, ceramic-to-metal, or fused metal oxide-to-metal hermetically sealed package. No multiple diodes per leg construction shall be permitted. The silicon die in each discrete diode shall be metallurgically bonded directly to the terminal pins. The completed assembly of diodes and other internal structures shall be encapsulated in a plastic material which polymerizes to a rigid condition by virtue of a chemical cross-linking mechanism. The rectifier bridge shall be free of voids either visible or as evidenced by failure to pass the environment test specified herein. Only those discrete diodes which have met these requirements shall be used in the rectifier bridge. Discrete diodes shall be manufactured and tested by the rectifier bridge manufacturer.

3.4.2 Terminal finish. Terminal finish shall be in accordance with MIL-PRF-19500.

3.5 Marking. Devices shall be marked as specified in MIL-PRF-19500.

3.6 Polarity. Polarity shall be as marked on figure 1.

3.7 Electrical performance characteristics. Unless otherwise specified herein, the electrical performance characteristics are as specified in 1.3 and table I herein.

3.8 Electrical test requirements. The electrical test requirements shall be the subgroups specified in table I, group A herein.

3.9 Workmanship. Semiconductor devices shall be processed in such a manner as to be uniform in quality and shall be free from other defects that will affect life, serviceability, or appearance.

4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

- a. Qualification inspection (see 4.2).
- b. Screening (see 4.3).
- c. Conformance inspection (see 4.4).

4.2 Qualification inspection. Qualification inspection shall be in accordance with MIL-PRF-19500 and as specified herein.

4.3 Screening (JAN, JANTX, and JANTXV). Screening shall be in accordance with table IV of MIL-PRF-19500, and as specified herein. The following measurements shall be made in accordance with table I herein. Devices that exceed the limits of table I herein shall not be acceptable. The JANTXV requirements apply to the internal discrete diodes only, not to the assembly.

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4.3.1 Discrete diode screening. One hundred percent of the internal discrete diodes shall be subjected to the following.

Screen (see table IV of MIL-PRF-19500)	Measurement
	JANTX and JANTXV levels
(1)	Thermal impedance (see 4.5.3)
9	Not applicable
11	I_{R1} and V_{F1}
12	See 4.3.1.1
(2) 13	Subgroup 2 of table I herein. $\Delta V_{F1} = \pm 0.1$ V dc; $\Delta I_{R1} = 100$ percent of initial value or ± 250 nA dc, whichever is greater.

- (1) Shall be performed anytime before screen 3.
(2) Except thermal impedance, if already performed.

4.3.1.1 Power burn-in conditions. Power burn-in conditions are as follows: Method 1038 of MIL-STD-750, test condition B, T_A = room ambient as defined in the general requirements of MIL-STD-750 (see 4.5), V_{RWM} = rated V_{RWM} (see 1.3), $I_O = 3$ A dc, $f = 50 - 60$ Hz.

4.3.2 Assembly screening. One hundred percent of the completed assemblies shall be subjected to the following.

Screen (see table IV of MIL-PRF-19500)	Measurement
	JANTX and JANTXV level
	Method 1051 of MIL-STD-750, condition F.
End points (1)	Subgroup 2 of table I herein.
Dielectric withstanding voltage	See 4.5.1

- (1) Except thermal impedance.

4.4 Conformance inspection. Conformance inspection shall be performed on the finished rectifier assemblies in accordance with MIL-PRF-19500 and as specified herein.

4.4.1 Group A inspection. Group A inspection shall be conducted in accordance with table V of MIL-PRF-19500 and table I herein.

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4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the conditions specified for subgroup testing in table VIb (JAN, JANTX, and JANTXV) of MIL-PRF-19500, and as follows. Electrical measurements (end-points) shall be in accordance with table I, group A, subgroup 2 (except thermal impedance) herein.

4.4.2.1 Group B inspection, table VIb of MIL-PRF-19500.

<u>Subgroup</u>	<u>Method</u>	<u>Conditions</u>
B1	2026	Immerse to insulating sleeve.
B2	1051	Condition F, 25 cycles.
B2	1071	Not applicable.
B3	1027	$I_0 = 0$ A dc; $T_A = +150^\circ\text{C}$; $V_{RWM} = 80$ percent rated V_{RWM} (see 1.3), $f = 60$ Hz, sampling plan = 10.
B5		Operational thermal cycling, (see 4.5.4).
B5	3105	Junction temperature test (see 4.5.2).
B6		Not applicable.

4.4.3 Group C inspection. Group C inspection shall be conducted in accordance with the conditions specified for subgroup testing in table VII of MIL-PRF-19500, and as follows. Electrical measurements (end-points) shall be in accordance with table I, group A, subgroup 2 (except thermal impedance) herein.

4.4.3.1 Group C inspection, table VII of MIL-PRF-19500.

<u>Subgroup</u>	<u>Method</u>	<u>Conditions</u>
C2	1056	Not applicable.
C2	2036	Test condition A, 6 pounds, $t = 30$ seconds.
C2	2036	Test condition D1, $t = 10$ seconds, 5 inch-pounds.
C2	1071	Not applicable.
C5	1001	Pressure = 8 mm Hg; $I_R = 2.0$ μA dc maximum, $V_R =$ rated V_{RWM} (see 1.3), (applied between all terminals to the case), $t = 60$ seconds; sampling plan = 15, $c = 0$.
C6	1026	$I_0 = 0$ A dc; $T_A = 150^\circ\text{C}$; $V_{RWM} = 80$ percent rated V_{RWM} (see 1.3), $f = 60$ Hz.
C7	4066	$V_{RWM} = 0$ V, bridge $I_0 = 25$ A dc (entire bridge biased); $T_C = 55^\circ\text{C} + 10^\circ\text{C}, - 0^\circ\text{C}$; $I_{FSM} = 150$ A (pk) (each device per bridge leg); $t_p = 8.3$ ms; 10 surges per leg at maximum 1 minute intervals; sampling plan = 10.
Alternate condition: Each leg may be biased separately to $I_0 = 12.5$ A dc per leg. All other conditions the same as above.		

4.5 Methods of inspection. Methods of inspection shall be as specified in the appropriate tables and as follows.

4.5.1 Dielectric withstanding voltage. This test shall be performed with the metal case of the assembly connected to ground and all terminals connected to the high potential side of a dc power supply or a scope display test set. The voltage applied between the terminals and the case, shall be 2,800 volts dc. Any discontinuity or dynamic instability of the trace, or a breakdown current in excess of 10 μ A dc, shall be cause rejection.

4.5.2 Junction temperature test. This test shall be performed in accordance with method 3105 of MIL-STD-750. The maximum junction temperature for any diode in the bridge at the below specified conditions shall be 175°C maximum. The test conditions shall be as follows:

$T_C = 55^\circ\text{C}$	or $T_C = 100^\circ\text{C}$
$I_O = 25 \text{ A dc}$	$I_O = 15 \text{ A dc}$
$I_{\text{ref}} = 10 \text{ mA dc}$	$I_{\text{ref}} = 10 \text{ mA dc}$

4.5.3 Thermal response. ΔV_F measurement shall be performed in accordance with method 3101 of MIL-STD-750. The following parameters shall apply:

- Measurement current (I_M) 10 mA.
- Heating current (I_H) 10 A minimum.
- Heating time (t_H) 10 ms.
- Measurement time delay (t_{MD}) 100 μ s maximum.

The maximum limit for $Z_{\theta JX}$ under these test conditions is 1.5 $^\circ\text{C/W}$.

4.5.4 Operational thermal cycling. This test shall be performed by connecting a single phase 50-60 Hz sine wave input to the ac terminals of the bridge. The resistive load or input voltage shall be made variable in order to maintain a rated bridge output current of 25 amperes dc. Bridge case temperature shall be maintained at 55°C except during the cooling cycle when case temperature shall be permitted to drop 20°C maximum. Life-test duration shall be 2,000 cycles with a heating time of 8 minutes, +10, -0 minutes and a cooling time ≥ 2 minutes.

TABLE I. Group A inspection.

Inspection <u>1/</u>	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 1</u>						
Visual and mechanical inspection	2071					
<u>Subgroup 2</u>						
Thermal impedance/leg	3101	See 4.5.3	$Z_{\theta JX}$		1.5	°C/W
Forward voltage/leg	4011	$I_F = 39 \text{ A dc (pk)}$ $t_p = 8.3 \text{ ms;}$ duty cycle ≤ 2 percent	V_{F1}	0.9	1.40	V (pk)
Reverse current/leg	4016	DC method; $V_R = \text{rated}$ V_{RWM} (see 1.3)	I_{R1}		2.0	$\mu\text{A dc}$
Breakdown voltage/leg	4021	$I_R = 50 \mu\text{A dc}$	$V_{(BR)1}$			
SPA25				110		V dc
SPB25				220		V dc
SPC25				440		V dc
SPD25				660		V dc
<u>Subgroup 3</u>						
High temperature operation:		$T_C = 100^\circ\text{C}$				
Reverse current/leg	4016	DC method; $V_R = \text{rated } V_{RWM}$ (see 1.3)	I_{R2}		150	$\mu\text{A dc}$
Low temperature operation:		$T_A = -55^\circ\text{C}$				
Reverse current/leg	4016	DC method; $V_R = \text{rated } V_{RWM}$ (see 1.3)	I_{R3}		50	$\mu\text{A dc}$
<u>Subgroup 4</u>						
Reverse recovering time/leg	4061	Condition B; $I_F = 0.5 \text{ A,}$ $I_R = 1.0 \text{ A, } I_{rec} = 0.25 \text{ A}$	T_{rr}		2.5	μs
<u>Subgroups 5 and 6</u>						
Not applicable						

1/ For sampling plan, see MIL-PRF-19500.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The notes specified in MIL-PRF-19500 are applicable to this specification.

6.2 Acquisition requirements. Acquisition documents must specify the following:

- a. Title, number, and date of this specification.
- b. Issue of DoDISS to be cited in the solicitation and if required, the specific issue of individual documents referenced (see 2.2.1).
- c. The terminal finish as specified (see 3.4.2).
- d. Type designation and quality assurance level.
- e. Packaging requirements (see 5.1).

6.3 Interchangeability. JAN devices previously manufactured to MIL-PRF-19500/446 were constructed with JANTX level devices and are the same product assurance level as the JAN and JANTX devices in this revision. JAN and JANTX devices are identical for all requirements of this specification except the device marking and are directly interchangeable. The JANTX device is the preferred PIN for new design and acquisition.

6.4 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Manufacturer's List (QML) No.19500 whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from Defense Supply Center, Columbus, ATTN: DSCC-VQE, P.O. Box 3990, Columbus, OH 43216-5000.

6.5 Changes from previous issue. The margins of this specification are marked with an asterisk to indicate where changes from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

Custodians:

Army - CR
Navy - EC
Air Force - 11
NASA - NA
DLA - CC

Preparing activity:

DLA - CC

(Project 5961-2452)

Review activities:

Army - MI
Air Force – 19, 71, 99

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
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I RECOMMEND A CHANGE:

1. DOCUMENT NUMBER
MIL-PRF-19500/446C

2. DOCUMENT DATE
5 March 2002

3. DOCUMENT TITLE

SEMICONDUCTOR DEVICE, SILICON, HIGH-POWER, SINGLE PHASE, FULL WAVE BRIDGE RECTIFIER, JAN, JANTX, AND JANTXV TYPES SPA25, SPB25, SPC25, SPD25

4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle initial)

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